

Remarks/Arguments:

By this Amendment, applicants have amended claim 11. Claim 11 is the only pending claim.

Claim Rejections Under § 112

Claim 11 stands rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for reasons set forth at numbered paragraph 2 of the Office Action. Applicants have amended claim 11 to more clearly indicate that applicants are claiming an intermediate interconnect structure and not a method. The language following "thereby" is merely added to help one skilled in the art reading the claim to understand the ultimate purpose for the intermediate interconnect structure. Such language is not unusual, and in fact is often invited by Examiners to help one skilled in the art understand the claimed invention.

Applicants respectfully submit that as amended, claim 11 is in full compliance with the Section 112.

Claim Rejections Under § 102

Claim 11 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Hoebener; and claim 11 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Crafts. By this Amendment, applicants respectfully traverse the § 102(b) rejections.

Applicants' claim 11 defines an intermediate interconnect structure comprising an intermediate solder assembly which includes the followings:

- a Pb-rich ball attached to the semiconductor chip and having an outer surface, and,
- a thin cap layer of Sn on the outer surface of the Pb-rich ball,
- the Sn layer having a thickness of less than 10.2 µm (0.4 mils) and having a melting temperature lower than that of Pb.

It is applicants' retention that the above identified features of the intermediate solder assembly are neither taught nor suggested in the Hoebener and Crafts Patents. It is applicants' further contention that these features are not process features, but are structural features identifying

the specific properties of the individual elements of the intermediate solder assembly. Applicants respectfully disagree with the Examiner that "Pb-rich ball" is process language. Applicants also disagree with the Examiner and instead contend that identifying the property of the thin cap layer of Sn having a melting temperature lower than that of Pb is not process language, but instead specifically identifies a property of the Sn layer.

The Examiner has identified specific figures in both the Hoebener and Crafts Patent which show balls of Sn/Pb, but these patents simply do not teach or suggest the specific structure which applicants are claiming as their invention.

As pointed out to Examiner Vu during an earlier telephone interview, applicants' invention is directed to an intermediate interconnect structure for a semiconductor chip of an intermediate solder assembly including a Pb-rich ball with a thin cap layer of Sn on the Pb-rich ball. Applicants specifically define the Sn layer to a thickness of less than 10.2 μm . Applicants are not claiming the solder assembly that may result from further reflow and annealing of the nonreflowed solder assembly defined in claim 11.

In addition, applicants have pointed out to Examiner Vu in that earlier telephone interview that the advantage of this thin cap of Sn on the Pb-rich ball is that deposits of Sn are not found on the outer surface of the Pb-rich ball during reflow and subsequent reflows. Thus, the specifically defined thin cap layer of Sn prevents subsequent deposits of Sn on the Pb-rich ball during subsequent reflows which applicants have found to cause contact problems with the semiconductor chip and circuit cards.

The intermediate structure which applicants' claim is a Pb/Sn, lead rich, ball with a thin Sn cap prior to reflow. The thickness of the Sn cap defined as less than 10.2 μm is important to this intermediate structure for subsequent reflow connection and future connection reliability. It is Applicant's claimed structure that provides the subsequent processing advantage during low temperature solder reflow processing, because there must be a tin cap to subsequently achieve a reflow and connection at a lower temperature than would be needed by just a lead rich ball alone. Applicants claim a structure of a cap that is thin enough such that substantially all of the Sn is ultimately diffused into the ball and intermixed throughout, such that the solder connection subsequently acts like a high melt solder connection during reflow processes. This is important to maintain the initial connection and future reliability of the connection after subsequent reflow processes such as module or card touch up, rework, or other such

operations that require the assembly to exceed the low temperature that was initially used to reflow the solder connection created by the lead rich ball with the tin cap.

Applicants note that the Crafts Patent and the Hoebener Patent describe solder balls. For example, solder ball 19 is shown in Fig. 8 of the Crafts Patent and a solder ball 12 is shown in Fig. 12 of the Hoebener Patent. But neither of these references teach or suggests the intermediate interconnect structure of applicants claimed invention of a intermediate solder assembly wherein a thin cap layer of Sn of a thickness of less than 10.2 µm is deposited on the Pb-rich ball, thereby preventing electrical connection problems during subsequent reflow of a solder ball assembly, as a result of deposits of Sn. It is applicants position, therefore, that the intermediate interconnect structure defined by claim 11 is simply not taught or suggested in the Crafts and Hoebener Patents. Applicants request that the Section 102(b) rejections be withdrawn.

Based on the foregoing remarks and amendments, applicants respectfully submit that claim 11 is in condition for allowance. Reconsideration and allowance of claim 11 is respectfully requested.

Respectfully submitted,

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